

METHOD FOR MANUFACTURING TIRES

TECHNICAL FIELD

[0001] The present invention relates to a method of manufacturing tires and, in particular, to a method of forming, upon building of a green tire, two or more carcass plies on the surface of a substantially toroidal core comprised, in many instances, of a rigid material.

BACKGROUND ART

[0002] There is known a method in which inner liners, carcass plies, belt layers, tread rubber, etc., are formed on a rigid core with a toroidal shape, having an outer surface that corresponds to the inner surface shape of the product tire. In this instance, as shown in a perspective view of FIG. 7, an inner liner 52 is formed on the outer surface of the rigid core 51, and an inner bead layer 53 is formed on an inner peripheral region at a side portion of the rigid core 51 by continuously winding, in the circumferential direction of the core 1, a bead wire in a spiral manner, for example. A carcass cord 54 is then applied onto the core 1 over its crown portion and side portions, so as to extend in the meridian direction of the core 1. A substantially U-shaped folded portion 55 is formed by folding back the carcass cord 54 at a region on the radially inner side of the inner bead layer 53, in combination with an indexing movement of the core 51 in the circumferential direction, by a predetermined angular range. These steps are repeated over an entire periphery of the core 1 until formation of a carcass ply 56 is completed, which is comprised of one or more continuous carcass cord 54. An outer bead layer 57 is formed at a radial position corresponding to the inner bead layer 53, by a similar winding of another bead wire. The inner and outer divided bead layers 53 and 57 are arranged in pair, so as to anchor the radially inner end portion of the carcass ply 56.

[0003] Furthermore, Patent Document 1 (Japanese Patent Application Laid-open Publication No. JP 11-115420 A, which is derived from the assignee's earlier patent application) proposes to form two or more carcass plies on a core by shifting the circumferential position of the carcass cord, so as to provide an overlapping region between the carcass plies, at the folding back position of the cords, and to thereby improve the withdrawal resistance of the carcass cord from the clamped position between the bead wire layers.

- Patent Document 1: Japanese Patent Application Laid-open Publication
No. JP 11-115420A

DISCLOSURE OF THE INVENTION

(Task to be Solved by the Invention)

[0004] Since the conventional technology as mentioned above is intended to provide tensile strength of the carcass plies, by anchoring the radially inner end portion of the carcass plies between a pair of inner and outer bead layers, it would be difficult to sufficiently improve the tensile strength of the carcass plies in a product tire. Thus, there may arise a problem of poor lateral rigidity of the tire as compared to widely used tires of general structure, thereby causing degradation in response characteristic of the tire upon lane change of the vehicle, for example. Furthermore, due to insufficient tensile strength of the carcass plies, it would be difficult to apply the conventional technology to the production of large-sized tires.

[0005] Moreover, in the conventional structure in which the carcass plies are anchored between the bead layers, the rigidity of the bead portion in a product tire cannot be sufficiently improved. Thus, there may arise a further problem that when the structure is applied to a run-flat tire in which the wheel load upon puncture of the tire is supported by reinforcing rubbers that are arranged on the inner surface side of the sidewall portions, the bead bases of the tire tend to undergo a prematurely dislocation into the well of the rim during the so-called run-flat running.

[0006] The present invention has been conceived in view of these problems of the prior art. Thus, it is an object of the present invention to provide a method for manufacturing tires so that the carcass plies of the tire built on a toroidal core have a sufficiently high tensile strength, thereby avoiding degradation in lateral rigidity of the tire and allowing production of large-sized tires, while significantly improving the rigidity of the bead portions so as to eliminate or substantially mitigate the risk of dislocation of the bead portions into the well of the rim during the run-flat running.

(Measures for Solving the Task)

[0007] According to the present invention, there is provided a method for manufacturing tires, wherein at least one carcass ply is formed by continuously applying a carcass cord onto an outer surface of a substantially toroidal core, over an entire periphery thereof, and various tire constitutive members are applied onto an outer surface of the carcass ply, so as to build a green tire. The method comprises: forming an inner carcass ply by feeding a carcass cord in a meridian direction of the core, and folding back the carcass cord at each side portion of the core; turning-up each radially inner peripheral portion of the inner carcass ply radially outwards about a bead; subsequently applying a skim rubber onto an

outer surface of the inner carcass ply, which has been formed with the turned-up portions; forming an outer carcass ply of a so-called down-structure, by feeding a carcass cord in the meridian direction of the core, and folding back the carcass cord at each side portion of the core; and applying the outer carcass ply onto an outer surface of the skim rubber.

5 [0008] It is preferred that the outer carcass ply of the down-structure is arranged so that radially inner peripheral edges thereof are overlapped with the respective turned-up portions of the inner carcass ply. It is further preferred that the skim rubber is arranged over an entire region where the outer carcass ply is overlapped with the turned-up portions of the inner carcass ply.

10 [0009] In the method according to the present invention, a reinforcement rubber having a crescent-like cross-section may be applied at a side region of the core, onto an inner surface of the inner carcass ply and, more precisely, also on an outer surface side of the inner liner.

[0010] In this instance, there may be applied a similar reinforcement rubber having a
15 crescent-like cross-section, between the inner carcass ply and the outer carcass ply at side region of the core, in place of the skim rubber.

(Effects of the Invention)

[0011] With the method for producing tires according to the present invention, by turning-up the inner carcass ply radially outwards about the bead cores, the carcass ply is
20 anchored in the same manner as in generally used tires, to provide a sufficiently improved tensile strength of the carcass ply in a product tire. Such improvement is further enhanced by the outer carcass ply which is adhered by vulcanization to the inner carcass ply through the skim rubber. It is thus possible to avoid degradation in lateral rigidity of the tire, and preserve a sufficient tensile strength of the carcass plies as required for
25 large-sized tires.

[0012] According to the present invention, furthermore, by turning-up the carcass ply about the bead cores, it is possible, not only to improve the rigidity of the bead cores, per se, as compared to the conventional bead of the above mentioned divided structure, but also to effectively restrain the carcass plies from displacement, deformation, etc., and to
30 sufficiently reduce the thickness of the rubber layer to be arranged on the radially inner side of the bead cores. It is thus possible to realize a high rigidity in the bead portion of the product tire, and effectively avoid dislocation of the bead cores into the well of the rim during a run-flat running of the tire.

[0013] In the method according to the present invention, when the outer carcass ply of

the down-structure is arranged so that radially inner peripheral edges thereof are overlapped with the respective turned-up portions of the inner carcass ply, it is possible to further improve the tensile strength of the carcass plies and the rigidity of the bead portions, and also to prevent occurrence of discontinuity of the rigidity at the tire bead portions or sidewall portions.

[0014] Thus, even large-sized tires, such as tires for trucks, buses or for off-road use, can be built on a core. In addition, the improved rigidity of the bead portions makes it possible to reduce the volume of the bead fillers to realize a tire that is light in weight, and suppress heat generation within the tire.

[0015] In this instance, when a skim rubber is arranged over an entire region where the outer carcass ply is overlapped with the turned-up portions of the inner carcass ply, a mutual contact of the respective ply cords in the overlapped region is prevented so as to effectively mitigate the risk of fretting fracture of these cords.

[0016] On the other hand, since the rigidity of the tire bead portions can be sufficiently improved, it is possible to realize a run-flat tire in which reinforcement rubbers are applied to the inner surface of the inner carcass ply in the side portions of the core. In addition or alternately to the provision of such reinforcement rubbers, it is possible to realize a run-flat tire in which reinforcement rubbers are applied between the outer and inner carcass plies in the side portions of the core.

[0017] In the latter case, even when the skim rubber is removed from the region in which the reinforcement rubber is arranged, the outer and inner carcass plies are sufficiently adhered to each other by vulcanization, through the reinforcement rubber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIGS. 1(a) through 1(d) are schematic perspective views showing the steps in the method according to one embodiment of the present invention;

FIG 2 is a schematic developed plan view showing one example of the inner carcass ply;

FIGS. 3(a) and 3(b) are schematic developed plan views showing further examples of the inner carcass ply;

FIGS. 4(a) and 4(b) are schematic sectional views showing the manner of turning-up the inner carcass ply;

FIG 5 is a schematic perspective view showing the turned-up portion of the carcass ply;

FIG 6 is a schematic sectional view showing one example of arrangement of the

reinforcement rubbers; and

FIG. 7 is a schematic perspective view showing the prior art.

BEST MODE FOR CARRYING OUT THE INVENTION

[0019] A preferred embodiment of the present invention is shown in FIG. 1 in which a
5 rigid core 1 of substantially toroidal shape has an outer surface previously applied with an
inner liner 2 of a predetermined thickness. The inner liner 2 may be formed, for
example, by a spiral or helical winding of the ribbon-like rubber strip and lamination of
the strip winding layers. As shown in FIG. 1(a), at least one carcass cord 3 comprised of
an organic fiber material is applied onto the outer surface of the inner liner 2, from one
10 side portion of the core 1 to the other side portion, so as to linearly extend in the meridian
direction. At each side portion of the core 1, the carcass cord 3 is folded back in a
U-shaped manner, while causing an indexing movement of the core 1 in a predetermined
direction, over a predetermined angular range. These operations are repeated over an
entire circumference of the core 1, so as to form an inner carcass ply 4, which is
15 continuous in a zigzag manner, as shown in the developed view in FIG. 2.

[0020] In this instance, it is preferred to use a carcass cord 3 which has been subjected
to a dipping process for improving the adhesion to the rubber. The above-mentioned
application of the carcass cord 3 may be performed by using an apparatus disclosed in
Japanese Patent Application Laid-open Publication Nos. JP 2000-52448A and JP
20 2002-127268A. The apparatus disclosed in the former patent document includes a
swinging feed mechanism for causing a reciprocating movement, in the meridian
direction of the core 1, of the cord passage provided at the tip end of an arm, a pin for
winding and supporting the carcass cord 3 at a folding back position in the reciprocating
movement of the cord passage, and a pressure mechanism including a pressure member
25 that is movable toward and away from the pins, for urging the wound portion of the
carcass cord 3 against the core 1. The pressure mechanism follows the indexing
movement of the core 1 to undergo a swinging movement in the indexing direction, and is
returned to its initial position after the pin has been separated from the core.

[0021] The apparatus disclosed in the latter patent document serves to ensure that the
30 folded back portions of the carcass cord is more positively applied to the core 1, and thus
includes a pin for winding and supporting the carcass cord 3 at the folding back portion in
the reciprocating movement of the cord passage, and a pressure mechanism that is
movable toward and away from the pins, for urging the wound portion of the carcass cord
3 against the core 1. The pressure mechanism is comprised of a pressure block that

follows the indexing movement of the core 1 to move in the indexing direction, as well as a movement suppression block that is movable by an amount corresponding to two pitches of the indexing movement of the core 1 while urging the wound portion of the carcass cord 3 against the core 1, the carcass cord having been already applied to the outer peripheral surface of the core 1.

[0022] The inner carcass ply 4 is formed as shown in the developed view of FIG. 2, though it may be alternatively formed so that two or three carcass cords 3 are overlapped with each other at the folding back positions 5, as shown in the schematic developed plan view of FIGS. 3(a) or 3(b), or four or more carcass cords are overlapped with each other in the similar manner.

[0023] After the inner carcass ply 4 has been formed, as shown in FIG. 1(b), annular bead cores 6 held by a bead setter or the like are positioned relative to predetermined locations in the side portions of the core 1. Subsequently, as shown in FIG. 1(c), the inner peripheral portions 7 of the carcass ply 4, which are to be situated on the radially inner side of the bead cores 6, are turned-up radially outwards about the bead cores 6 so as to form turned-up portions 7a.

[0024] In this instance, the turning-up of the inner peripheral portions 7 in the inner carcass ply may be performed, for example, by a radial expansion deformation of bladders arranged in the inner peripheral portion of the core 1, or by successive operation of a mechanical expansion / contraction means, which is arranged in a predetermined storage position of the core 1, so that it is successively moved axially outwards and radially outwards. The turning-up of the inner peripheral portions 7 may be performed so that, as shown in a schematic sectional view in FIG. 4(a), the turned-up edge E of the carcass ply 4 is spaced from the main body portion of the carcass ply 4 or, as shown in FIG. 4(b), the turned-up edge E is alternatively in contact with the main body portion of the carcass ply 4.

[0025] In any of these cases, there may be arranged bead reinforcement rubbers, such as bead fillers having a thickness that is gradually reduced radially outwards, on the outer peripheral side of the bead core 6 and between the main body portion and the turned-up portion of the carcass ply 4.

[0026] FIG. 5 is a perspective view showing the turned-up portion 7a of the carcass ply 4 such as that shown in FIG. 3(a). This turned-up portion 7a includes carcass cords 3 which are crossed at their folding back portions so as to restrain each other, thereby further improving the withdrawal resistance of the carcass ply 4.

[0027] Subsequently, as shown in FIG. 1(d), a skim rubber 8 comprised of a ribbon-like rubber strip is wound spirally or helically on the outer surface of the inner carcass ply 4, and an outer carcass ply 10 is applied onto the outer surface side of the skim rubber 8. The outer carcass ply 10 may be formed in the same manner as the inner carcass ply 4, by
5 applying a carcass cord 9 so as to extend in the meridian direction and folding back the carcass cord 9 at each side portion of the core 1. In this instance, the skim rubber 8 serves to prevent mutual contact of the inner carcass ply 4 and the outer carcass ply 10 with each other, thereby eliminating the risk of premature wear or fracture of the ply cords.

10 [0028] It is needless to mention that the formation of the outer carcass ply 10 also may be such as that shown in FIG. 2 or FIG. 3(a) or 3(b). However, it is preferred that the outer carcass ply has an inner peripheral edge that is positioned, as shown by imaginary lines in FIGS. 4(a) and 4(b), at a location corresponding to any region in the turned-up portion 7a of the inner carcass ply 4.

15 [0029] When the inner and outer carcass plies 4, 10 are formed in the manner explained above, if the tire to be built is a run-flat tire, reinforcement rubbers of crescent-shaped cross-section may be arranged in each side portions of the core 1, at a location between the inner liner 2 and the inner carcass ply 4 and/or a location between the inner and outer carcass plies 4, 10. Such reinforcement rubber may be formed by winding and
20 laminating a ribbon-like rubber strip in desired regions, to have a desired cross-sectional shape.

[0030] In this instance, when reinforcement rubbers are interposed between the inner and outer carcass plies 4, 10, the reinforcement rubbers effectively contribute, at least in their regions, to provide an improved adhesion between these carcass plies through
25 vulcanization. Thus, it is preferred to remove the skim rubber 8 from the region of the reinforcement rubbers, in view of avoiding increase in the weight and production cost of the tires.

[0031] FIG. 6 is a schematic sectional view showing an arrangement which includes the reinforcement rubbers at both locations. Reference numeral 11 denotes an inner side
30 reinforcement rubber that is interposed between, and adhered to the inner liner 2 and the inner carcass ply 4, and reference numeral 12 denotes an outer side reinforcement rubber that is interposed between, and adhered to the inner carcass ply 4 and the outer carcass ply 10.

[0032] After the formation of the inner and outer carcass plies 4, 10 has been completed

in the manner explained above, further tire constitutive members, such as belt layers, tread rubber, sidewall rubbers, rubber chafers, etc., which are not shown in the drawings, are formed and/or arranged on the outer side of the carcass plies 4, 10, so as to complete building of a desired green tire.